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A Quarter Century Effort Yet to Come of Age

A Survey of Power Sector Reforms in Developing Countries

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Abstract

It has been more than two decades since the widespread initiation of global power sector reforms and restructuring. However, empirical evidence on the intended microeconomic, macroeconomic, and quality-related impacts of reforms across developing countries is lacking. This paper comprehensively reviews the empirical and theoretical literature on the linkages between power sector reforms, economic and technical efficiency, and poverty reduction. The review finds that the extent of power sector reforms has varied across developing countries in terms of changes in market structures, the role of the state, and the regulation of the sector. Overall, the reforms have improved the efficiency and productivity in the sector among many reforming countries. However, the efficiency gains have not always reached the end consumers because of the inability of sector regulators and inadequate regulatory frameworks. Reforms alleviate poverty and promote the welfare of the poor only when the poor have access to electricity. From a policy-making perspective, this implies that the reforms need to be supplemented with additional measures for accelerating electrification to help the poor.

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A Quarter Century Effort Yet to Come of Age:

A Survey of Power Sector Reforms in Developing Countries

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1. Introduction

Electricity sectors across the globe have experienced a major experiment of introducing market-oriented reforms and restructuring in response to a combination of political, ideological, economic and technological factors starting in the early 1980s and gaining pace since the 1990s. The reforms aimed at introducing energy policies, legislation, regulations and institutions that would dismantle the monopoly of state-owned utilities and provide opportunities for private actors to participate in a competitive market (Ljung, 2007). Moreover, market driven economic reforms are ongoing in many countries although the pace of the reform process has varied across countries. For example, by the end of the 1990s, the majority of OECD countries and over 70 developing and transition countries had taken some steps toward reforming their electricity sector through high and low level measures (Besant-Jones, 2006).

The high level reform measures focussed on introducing competition in the wholesale and retail segments of energy supply, the horizontal unbundling of the incumbents to create viable competitors, the creation of an independent regulatory body and often (but not necessarily always) privatization. These measures allowed the corporatization of the different segments of the energy supply and also facilitated the vertical separation between the natural monopolies and the potentially competitive segments of the vertically integrated energy sectors that were monolithically owned and managed by state governments before reforms. Vertical separation of these distinct activities of the energy supply industry (ESI) was believed to guard against cross-subsidization between the competitive businesses and regulated businesses of energy supply and discriminatory practices such as denial of access to networks (Joskow, 2006). The degree of vertical separation (or unbundling) varied in terms of functional separation, accounting separation, legal separation and ownership separation. The low level reform measures included aspects of cost-reflective pricing (such as removal of subsidies and subsidies restructuring, tariff liberalisation and price setting), adoption of new energy technology, new financial schemes and community involvement (Prasad, 2008).

Thus, a successful electricity reform is expected to enhance the efficiency of the sector, improve energy service reliability and service quality, reduce the price-cost gap through cost-reflective pricing and increase investments (Newbery, 2002; Jamasb, 2006; Kessides, 2012). Successful power sector reform were expected to benefit the poor by providing access to energy services, improvements in cost efficiency, improvements in other services such as health, education and communications; and stimulation of economic development and improvements in public sector finances (Davies et al., 2003). A key question is the extent to which these goals

have been achieved considering that ample amounts of financial resources and effort have already been used in the reforming countries.

Answering this question requires revisiting the theoretical rationale and examining the empirical evidence of power sector reforms against their anticipated objectives. However, a comprehensive analysis of the impacts of power sector reforms on several sector specific and macroeconomic dimensions including energy prices, energy supply quality, utility performance, economic growth, social welfare and poverty reduction is missing in the existing energy reform literature. On the other hand, there has been a renewed interest in the relationships between power sector reforms, efficiency, growth, and welfare in the light of climate change and energy security concerns (Nepal and Jamasb, 2015). For example, the UK, one of the pioneers of market-based reforms, proposed a new electricity market reform in 2010 signalling the desire for more government intervention in order to meet its ambitious climate change objectives (DECC, 2011). The renationalization of electricity industries in Latin American countries such as Bolivia, República Bolivariana de Venezuela and the Dominican Republic has underscored the changing but significant role of the state in market-based reforms (Balza et al., 2013). For example, Argentina, once at the forefront of reform, is now curbing the role of markets in the energy sector (Littlechild, 2013).

Nearly 30 years since the first power sector reform in Chile, it is timely to take stock of the cumulative reform experience with market-based reforms of this important and ongoing experiment. The reforms have proven much more difficult than first anticipated and most remain work in progress. This paper also attempts to close the gaps in the electricity reform literature by reviewing the process and micro-macro outcomes of power sector liberalisation and reform and synthesizes relevant policy lessons for policymakers in (re) formulating the (existing) new power sector reforms and policies. An earlier study by Jamasb et al. (2005) reviewed empirical evidence on electricity reform in developing countries by focussing on the operating efficiency and electricity access impacts. However, we have considered both empirical and theoretical literature on the linkages between electricity sector reforms; economic and technical efficiency, economic growth, welfare and poverty reduction in developing countries. In doing so, this paper aims to measure reform performance, clearly explore the link between the theory and practice of electricity reforms filling an important gap in the existing literature and reach rigid conclusions on the performance of reforms from a policymaking perspective. We do not examine the impact of reforms on the environment. It suffices to state that reforms may or may not have negative environmental impacts. However,

this is rather a matter of devising proper environmental policies and is, therefore, separate from the reforms per se.[1]

The remainder of the sections are structured as follows. Section 2 provides an overview on the drives, context and status of electricity reforms around the world. Section 3 discusses the different methodological approaches to studying the impacts of reforms and analyse the impacts of energy sector reforms on several industry specific and macroeconomic dimensions. Section 4 synthesizes the insights from the reforms and policy lessons. Section 5 concludes the paper.

2. Overview: Drivers, Context and Status of Reforms

Electricity sector reforms based on the 'standard textbook model' became a global trend during the 1990s. The textbook model was first applied in the Chilean power sector in 1982 and also became the reference model for reforms in other energy sectors. The textbook model for reforms involved the following reform sequence and steps: i) corporatization of state-owned enterprise, ii) law for electricity sector liberalization, iii) establishment of an independent regulator, iv) unbundling (vertical separation) of the main segments, v) incentive regulation of electricity networks, vi) establishment of a wholesale electricity market, vii) privatization and viii) introduction of independent power producers (IPPs). The model brought about a fundamental paradigm shift in terms of electricity sector market structures, the role of the state, and the regulation of the sector (Joskow, 1998; Newbery, 2002).

The structures of electricity markets have a strong influence on whether and the extent to which reforms can achieve improvements in performance. Creating competitive wholesale and retail electricity markets by undertaking vertical separation were the eventual underlying aims behind market restructuring. Competition inevitably meant a reduction in state ownership, as private sector could freely participate in wholesale markets and take market share from incumbents (Pollitt, 2012). The reforms were aimed at expanding the scope for competition in the electricity sector either through 'competition in the market' or 'competition for the market' (Ljung, 2007). Hence, both domestic private firms and multinational corporations could participate as market actors. As a result, there was a strong push for privatisation and models

[1] A notable study by ESMAP (2011) shows that vertical unbundling tends to reduce carbon dioxide emissions by 5 percent indicating a higher degree of environmental sustainability.

of private sector participation such as the use of Public-Private Partnerships (PPPs) in the electricity sector (Vagliasindi, 2013).

The market-oriented reforms were followed by the need to create strong and effective new institutions in the form of independent electricity sector regulatory agencies. The separation of the natural monopoly segments of electricity supply from the competitive segments and privatisation placed much emphasis on economic regulation to ensure that public interests were properly reflected in terms of service quality, network access and tariffs while all generators had equitable access to the grid and consumers. The perverse incentives created by the cost-of-service regulation in terms gold-plated spending (see Averch and Johnson, 1962) implied that incentive regulation was encouraged to improve cost efficiency in electricity networks. It was assumed that incentive regulation of the monopoly electricity networks would mimic the outcomes of a competitive market (Littlechild, 1992).

Table 1 summarizes the drivers that contributed to the adoption of liberalised electricity reforms in developed and developing countries. The specific motives for reforms often varied between developing and developed countries while external drivers (factors outside the sector) played a key role in shaping electricity sector reforms. Poor operational and financial performance of the state led utilities; technological progress and development of the highly efficient gas-fired combined coal gas turbines (CCGTs); political faith on the forces of market, competition and privatization; pressures from international donor agencies; options for raising capital to the government and alongside reducing its Public Sector Borrowing Requirement (PSBR) were some of the major drivers of reforms (see Jamasb, Nepal, Timilsina and Toman, 2014).[2]

[2] For example, the World Bank officially changed its lending policy in 1992 and later followed by the Asian Development Bank (ADB); the European Bank for Reconstruction and Development (EBRD) and the Inter-American Development Bank (IADB) for electricity development from traditional project lending to policy lending. Almost $US 187 billion of private capital flowed into the economy of 76 developing countries during the 1990s (Beder, 2005). Privatization of state owned energy utilities reinforced the ideology of the Thatcher government and its interest in reducing the costs of domestic coal subsidies in the UK while similar ideological and political explanations can be found in Chile, Norway and New Zealand (Newbery, 2002; Hogan, 2002). Technological progress eliminated the significant entry barriers that had previously existed to entry in power generation and intensified competition in electricity generation. Likewise, Bolivia including other Latin American countries (LACs), Ghana and the transition economies (which includes the countries belonging to the former Soviet Union) are examples of energy sector privatization in the context of large debt crisis. Interestingly, privatisation in the LACs proceeded at such a speed that they contributed to about 40% of the total value of energy privatizations in the world during the 1990s (Gabriele, 2004).

Table 1: Drivers of electricity sector reforms

Electricity sector drivers	External drivers
Developed countries: excess capacity, use of costly generation technologies, economic inefficiency, growing consumer demands for cheap energy *Developing countries:* Lack of public sector financial resources to meet growing demand, institutional inefficiency, burden of energy subsidies, low service quality, high energy losses, poor service coverage, capacity shortage and energy sector investment constraints	a) *Political and economic ideology*: faith on the forces of market, competition and privatization b) *Technological innovation*: such as the development of CCGTs c) *Macroeconomic events*: such as the post-Soviet economic transition (1989), Latin American debt crisis (1980s), Asian financial crisis (1997-1998) d) *Capital raising options*: privatization of state owned energy assets e) *OECD energy deregulation*: creation of new energy multinationals looking for new investment opportunities f) *Lending policies of donors*: such as those of the World Bank and IMF with strings attached g) *National economic reform context*: as a result of economic crisis and structural adjustment programs

However, the sector's resource endowment, initial structure, size, and institutional strength differed across the reforming countries. Also, the design, scope, and implementation of reforms varied across countries. Inevitably, these factors came to play an important role in the extent of adoption and performance of market-oriented reforms. These conditions proved critical in determining the appropriate design and pace of sector reform for a country (World Bank, 2004). The *initial sector structure* defines the starting point of the reform process and is a given factor implying the importance of envisaging appropriate structure from the start of the reform process. The *institutional factors* refer to sector and economy level legal and regulatory framework that influence and support the continuity of the electricity sector reform process. The reforms and regulation of the electricity sector in developing countries tend to suffer from low levels of institutional environment in terms of limited regulatory capacity, limited accountability, limited commitment and limited fiscal efficiency (Laffont, 2005). The weak institutional environment implies that reforms and regulation of the sector can be ineffective.

Regulation (predominantly cost-based) can also be prone to political capture and becoming a tool of self-interest within the government or ruling elite in developing countries (Stiglitz,

1998). However, regulation by contract or a combination of regulation by contract and regulatory independence may provide a better regulatory framework for developing countries aiming to privatize their distribution systems (Bakovic, Tenenbaum, and Woolf, 2003). The *size of the electricity sector* can influence the reform capabilities and reform options of individual reforming countries. It is not clear if the smaller energy systems in developing countries require or benefit from vertical separation and third-party access. For example, the scope for competition may be limited implying that, in small energy systems; the benefits of liberalization and reforms may be small in relation to the costs.

Despite these notable differences, electricity sector reforms have been globally pursued under varying initial conditions. Some have had relative success while many have not lived up to the ambitions and expectations after more than two decades of reforms. For example, existing market driven reforms among OECD countries like Chile, Norway and Sweden appears to be performing well as compared to the UK, once considered as a successful model of electricity reforms. In contrast, the inability to attract private investments in the power sector in Sub-Saharan African countries like Uganda and Zambia remains a disappointment. According to the World Bank's Private Participation in Infrastructure database, there was a boom in IPPs during the 1990s, which subsequently abated with the arrival of the financial crisis in the late 1990s.

Reforms seem to have failed to correct the chronic underinvestment in power supply in most developing and transition countries, which also accounts for the poor performance of the sector in these countries. For example, there was very little investment in the power sector from 1991 to at least the mid-2000s except for the Russian Federation and Turkey in the European and Central Asian countries (Barbara, 2010). Some countries (such as in Latin America) have made relatively advanced transition to the market in the energy sector while some (such as China, Russia, South Africa) are caught between the state and the market where the state still plays a dominant role in electricity sector operation and management (Nepal, 2013). Table 2 summarizes the power sector reform experience among selected cases in a power sector reform matrix.

Table 2: Reform status of electricity sector in selected countries

Country	*Primary factors for reform*	*Key milestones of the reform process*	*Main outcomes*	*Limitation/ Challenges*
India	economic openness to foreign investment, poor performance of state-owned electric utilities	IPP entry in 1991, introduction of independent regulation act (at state level) was passed in 1998, Electricity Reform Act enacted in 2003	all states (29) have constituted and operated an independent regulator while 23 states have undertaken tariff reform, 20 states have implemented unbundling/corporatization, 2 states (Orissa and Delhi) have privatised distribution, 28 states have implemented third party access and 11 states have exercised multi-year distribution tariff orders	success of reform not encouraging, questionable outcomes base d on competition and privatisation, technical losses above 35% of power generation, power theft on-going, state-level corruption, subsidised tariffs
Thailand	supply shortages, government's massive debt, Asian financial crisis	1992 Electricity Law, IPP Law 1996, approval of independent regulator establishment in 1999, abandonment of price based pool in 2003, privatisation postponement in 2004, establishment of energy regulatory board in 2008	electricity market reforms remain inactive, uneconomic tariff structure which is disadvantageous to consumers, regulation ad incentive schemes do not promote efficiency but favour the state enterprises	political turmoil affecting reform implementation, regulatory institutions remain weak and not independent, state enterprises are favoured, promoting market competition difficult
Ghana	supply shortages, external lending policy, fiscal crisis, lack of investment, poorly performing distribution sector	World Bank requires reform as loan conditions in 1994, 1997 restructuring and privatization plan, regulator formed, IPPs introduced in 1998, reforms shelved by parliament in 2001, Volta River Authority (VRA) unbundled in 2008	reforms stalled, structure of the sector has not changed much, VRA mostly operating under financial losses, distribution losses remain high, tariff setting not economic and eroding the long term viability of utilities	regulator not independent from political interference, no standard form of PPA in the market, competing pressures to keep consumer tariffs low hampering the establishment of cost-reflective tariff
Fiji	fiscal problems,	1996 Public Enterprise Act, functional	productivity improvements, system losses reduced from 18% to 10%, tariff	regulator unable to make independent

	donors lending policy	separation in 1998, internal reform again started in 2002, tariffs increase by independent regulator in 2005	collection rates increased, more authority and discretion to independent regulators	decisions on tariff setting,,, unstable political environment can lead to low private sector involvement
Brazil	poor performance of state-owned utilities, demonstrations effects from Chile and Argentina	launched radical electricity sector reforms in 1996, privatisation began in 1995, creation of independent regulators in 1998, short term wholesale market created between 1995 and 2003, long term contracts model replaced the previous wholesale market between 2004 and 2005	increasing reverting to central planning, competition has improved in the sector, auction process in transmission provide competition and incentives for investors, distribution companies procure electricity at competitive price	excessive reliance on hydro can lead to energy crisis in the face of rising demand as in 2001-2002, decarbonisation a challenge when addressing issues associated with security of supply and diversity in generation, attracting private investments a necessary condition for the growth of the sector
China	electricity reforms pursued as a part of wider liberal economic reforms	corporatisation and commercialisation of sector in 1998, 1999 bidding by power generators, separation of generation from transmission and distribution in 2002, creation of state electricity regulatory commission in 2002, scheme for power price reform in 2003	overall reforms postponed, industry restructuring not accompanied by the introduction of competitive markets, entrenched interests have obstructed further reform, generating capacity doubled between 2002 and 2007	future of power sector reform uncertain, political will be important in moving forward with stalled reforms, institutions such as legal system and capital markets remain immature to support competitive markets
Russia	electricity reforms pursued as a part of wider liberal economic reforms after	establishment of joint stock company for electricity in 1992, reform principles adopted in 2001, regulatory framework of the	reforms stalled, lack of insufficient investments for system modernization and low carbon generation capacity, electricity pricing controlled by government for social equity concerns	blackouts in 2002 highlighted fragility of the system, destruction of hydropower plant in 2008

	Soviet-Union break up	reform established in 2003, gradual transition towards free market pricing in 2003, privatisation of quasi- monopolist in 2008, free market pricing in theory in 2011		highlighted the need for system modernisation, market pricing only in theory as government actively monitors electricity prices
South Africa	democratic revolution of 1994, poor performance of state-owned utilities, new international thinking	creation of an independent regulator in 1995, White Paper on Energy Policy published in 1998, announcement of no unbundling of the incumbent in 2004, White Paper on renewable energy published in 2003	overall reluctance to reform, post 1990 performance saw some improvements in quality and security of supply, rapid progress in extending electricity access, prices still low by international standards and below cost-recovery levels	urgent need for capacity expansion as capacity is tight, pricing principles of efficiency and cost-reflectivity necessary, transparency in subsidy programme needed

The single-buyer model dominates most of the electricity sectors in Asia, Africa and some transition countries as observed in Table 3. The single buyer model is perceived to be a reasonable second-best solution in countries where the competitive model would not work (Arizu, Gencer and Maurer, 2006). In contrast, most of the countries in Latin America have competitive wholesale arrangements and considerable reforms have been carried out with adherence to the standard reform model. The generation segment of the ESI has undergone privatization in many developing countries while the network segments remain publicly owned. The privatisation of the ESI has been largely pursued in Latin America while IPPs now occupy a large market in Asia, particularly in China, Indonesia, the Philippines, India, Pakistan, Malaysia and Thailand under a single-buyer model. Overall, many developing countries are still some distance away from the full adoption of liberalized standard model in their power sector and are by and large in transition from state control to markets.

Table 3: Power Sector Reform Matrix

Market Structure		***Private Ownership and Involvement***		***Regulation***	
China, Thailand, Vietnam, Nepal, Sri Lanka, Burkina Faso, Nigeria, Côte d'Ivoire, Zimbabwe, Senegal, Morocco, Tunisia	***monolithic single buyer***	China, Malaysia, Philippines, Thailand, Vietnam, Nepal, Lithuania, Turkey, Russia, Nicaragua, Colombia, Bolivia, Argentina, Brazil, Peru, Chile, Tunisia, Morocco, Kenya, Zimbabwe, Côte d'Ivoire, Uganda, Nigeria, Ghana, Cameroon, Bangladesh, Sri Lanka, India, Pakistan	***generation***	Malaysia, Philippines, Thailand, Pakistan, Bangladesh, Nepal Cameroon, Nigeria, Uganda, Côte d'Ivoire, Senegal, Kenya, Argentina, Bolivia, Chile, Peru, Brazil, Nicaragua, Colombia, Russia, Turkey, Azerbaijan, Kyrgyzstan	***independent regulators exists***
Malaysia, Philippines, Pakistan, Bangladesh, Ghana, Uganda, Kenya, Turkey, Lithuania	***unbundled single buyer***	Cameroon, Côte d'Ivoire, Argentina, Bolivia, Brazil, Chile, Peru, Nicaragua, Colombia, Russia, Lithuania	***transmission***		
Korea Rep., Cameroon, Uzbekistan, Turkmenistan, Tajikistan, Azerbaijan, Kyrgyzstan	***monopoly***	Philippines, Pakistan, Cameroon, Uganda, Côte d'Ivoire, Morocco, Chile, Brazil, Peru, Argentina, Bolivia, Nicaragua, Colombia,	***distribution***		

Argentina, Bolivia, Brazil, Chile, Colombia, Peru, Nicaragua, Russia	***wholesale competition***	Russia, Lithuania, Turkey, Azerbaijan			

Source: Ljung (2007) and authors' compilation

3. Assessing the Reform Impacts

Several approaches have been used in the literature to assess impacts of energy sector, particularly, power sector reforms. These include social cost-benefit analysis, econometric analysis, efficiency and productivity analysis, macroeconomic analysis and specific case studies.

A social cost-benefit analysis (SCBA) in principle considers energy reforms and restructuring as an investment and compares the costs of investment with the benefit which is the change in actual and projected performance relative to a defined counterfactual of what would have happened in the absence of reforms and restructuring (Jones et al., 1990). Hence, a SCBA is expected to estimate the overall welfare impact of energy sector reforms and the distribution of welfare. However, governments do not necessarily perform social-cost benefit analysis prior to reform and tend to rely on less formal types of assessment (Jamasb, Newbery and Pollitt, 2005). Moreover, energy sector reforms are multi-dimensional activities with many interacting factors, which cannot be captured by a SCBA.

Econometric analysis is used to test hypothesis through statistical analysis of reform determinants and performance thereby quantifying the effect of various reforms on the energy sector performance indicators. Performance metric regressions based on cross-section, panel data econometrics and time-series econometrics are applied for this purpose. Statistical tests to assess the significant differences in the performance metrics before and after reforms are often carried out by conducting a t-test. However, a t-test for significant performance differences cannot control for the effects of other variables as in a multivariable regression analysis.

Efficiency and productivity analyses are desirable for assessing the effectiveness to transform inputs into outputs, relative to best practice. Both parametric and non-parametric methods are used in measuring productivity and efficiency. Parametric methods use specified production or cost functional forms and apply econometric techniques. Typical parametric methods include regression analysis and stochastic frontier analysis (SFA). In contrary, non-parametric methods

use mathematical programming techniques and do not require specification of production or cost functions. Data Envelopment Analysis (DEA) is a commonly used non-parametric method that evaluates the performance of an agent relative to the frontier. Frontier methodologies measure efficiency as the distance to the frontier by constructing a cost or production function. Therefore, each individual agent is benchmarked against the best practice, also known as benchmarking (Jamasb and Pollitt, 2000). Efficiency and productivity analysis also reduce the need for rigorous data and especially when the data are hard to collect.

Macroeconomic analysis use macroeconomic models, such as computable general equilibrium (CGE) models to assess the quantitative impacts of energy reforms on the economy. The CGE models use actual economic data to estimate how an economy might react to changes in policy, technology or other external factors pertaining to energy reforms. The advantage of the reform studies based on CGE modelling is that these studies attempt to model the interaction effects of sector reform with non-reforming sectors and calculate the aggregate welfare effect directly.

Single or multi-country *case studies* are desirable when in-depth investigation or qualitative analysis is needed. These studies are useful when qualitative aspects of reforms such as regulation and conflict resolution and reform dynamics such as the implementation process are crucial factors in assessing the efficacy of the reforms (Jamasb et al., 2005). This is because these factors are inherently difficult to capture through statistical methods. Case studies can examine issues that do not easily lend themselves to rigorous quantitative analysis or could not be analysed due to a lack of comprehensive data (Jamasb, Newbery and Pollitt, 2005). Hence, case studies can overcome the issues associated with model specification and accuracy of variables in representing the relevant aspect of reform. Case studies involving single or multiple countries have been a popular technique to study the process and outcomes of energy sector reforms in many developing and developed countries.

Market-oriented electricity reforms, when implemented properly, should engender positive impacts on efficiency and other performance measures of the energy industry with desirable macroeconomic consequences. Reforms are expected to lead to cost-reflective energy pricing and the curtailment of energy subsidies while reducing the margins between price and cost (i.e. reducing the scope for market power abuse and exercise). Reforms should also enhance the technical, operational (including improved access to energy) and economic efficiency of the sector. The importance of energy as a production input and necessary final consumption good imply that energy reforms should be conducive towards economic growth and poverty reduction. Hence, the impacts of energy sector reforms can be studied as industry specific

impacts (encompassing energy prices/subsidies and technical/economic/operational efficiency) and macroeconomic impacts (economic growth, poverty reduction, welfare enhancement).

3.1. Microeconomic Impacts of Electricity Sector Reforms

This section reviews the relevant literature analyzing the impacts of energy sector reforms on several dimensions pertaining to the microeconomics of electricity industry including electricity pricing, economic efficiency and electricity service quality (e.g., reliability). As energy sector reforms are market-driven they rely on competition and price signals, reforms are expected to lower electricity costs and retail prices while improving the overall efficiency of the sector (Joskow, 1998). It is noteworthy that in developing countries removal of subsidies, a source of inefficiency, will result in increased prices. In this section we present evidence of meeting (or not meeting) this objective of the energy sector reforms.

3.1.1. Impacts of reforms on electricity pricing

Electricity reforms are expected to establish the primacy of pricing mechanism in the electricity industry by fostering competition and leading to improved efficiency and lower energy prices (Yang and Sharma, 2012). Reforms would encourage entry of new actors in energy markets by providing better incentives so that new entrants with more efficient technologies would create downward pressure on energy prices (Fan, 2007). Hence, sector reforms are expected to lead to lower electricity price-cost margins cost-reflective pricing move electricity prices towards their long-run marginal costs (LRMC).

However, there is no clear consensus regarding the evidence of reforms on energy price impacts in developing countries. The global evidence suggests that privatisation did not lower costs in the short run for the industry once allowance was made for ownership while government interference with investments decisions led to increased costs (Pollitt, 1995). Moreover, the evidence varies across different developing regions while the impacts of different reform steps on energy prices also differ. Three studies by Nagayama (2007; 2009) and Erdogdu (2011) are of notable importance in assessing the reform impacts on prices at the global level. For example, Nagayama (2007) show that the introduction of foreign IPPs, privatization and introducing retail competition lowered electricity prices in some regions and not all developing

countries they studied. Regulatory institutions in developing countries are often found to be not independent implying that political interference prevents energy prices from being-cost reflective. Country level corruption on contracts granted to the IPPs also prevented the reforms from producing their intended effects in developing countries such as in Southeast Asia (Henisz and Zelner, 2002). On the other hand, a study by ESMAP (2011) shows that vertical unbundling decreased electricity tariffs by 10% indicating a higher degree of competitiveness in developing countries.

Nagayama (2009) shows that cross-subsidies in electricity pricing declined with the progress in the electricity sector liberalization in Asian developing countries although liberalization models do not necessarily reduce average electricity prices. In Latin America, the impact of liberalization on electricity prices is mixed. The wholesale and retail prices have often risen due to unbundling and privatization in order to assure return in investment expected by private investors.

The effects of reforms on electricity price cost-margin (i.e. the difference between electricity price and cost) and cross subsidy levels can be different between industrial and residential consumers across both developing and developed countries. Participation of IPPs in the generation market and existence of wholesale markets seems to decrease industrial price-cost margin in Latin American countries (Erdogdu, 2011). Likewise, the establishment of wholesale electricity markets and a market regulator had a downward effect on the residential price-cost margins in developing countries. Unbundling an inherent element of the textbook reform model), with privatization, also led to a decreasing effect on residential price-cost margins in the developing countries in the Latin America. These evidence shows that each of the main reform steps can produce diverse impacts on the price-cost margins and cross-subsidy levels across different countries. On the other hand, the overall impacts of reforms on the industrial and residential price of electricity depend on the level of industry restructuring.

The impact of reforms on electricity prices has been less frequently studied on a regional basis and the focus of most research to date has been at the utility level. India provides an interesting case to assess the differences in regional outcomes of reforms considering the different states sharing a common economic and political system. Sen and Jamasb (2012) analyze the impacts of individual reform measures on key economic and power sector variables for different Indian states and showed that the average price of electricity was unaffected by reforms while passing of tariff order in different states as a mechanism to correct price distortions significantly lowered the industrial price of electricity. Tariff order also rationalized electricity pricing by

lowering the cross-subsidies between industrial and residential customers while unbundling lowered the cross-subsidy between industrial and agricultural customers. In Orissa, the average electricity tariff increased from 1991 to 2001 (Kundu and Mishra, 2011). However, the price of electricity sharply increased particularly for agricultural customers after reforms due to the abolishment of government subsidies. These studies confirm that reform outcomes in developing countries can be adverse during the initial stages of reforms.

In Latin America, the change in regulatory regime from cost-based to price-caps did not produce clear pattern of electricity price development although the changes in ownership and regulatory regime in the electricity distribution sector led to a decline in the retail price in general (Estache and Rossi, 2005). The price fall, however, did not match the corresponding productivity gains. However, a recent study by Balza, Jimenez and Mercado (2013) documented that an increase in cumulative private investment by 1% led to a 0.015% reduction in electricity prices across Latin America. The quality of regulation in reforming countries also significantly reduced the electricity prices. In Peru, the restructuring and privatization of the electricity distribution market led to price increases for consumers (Anaya, 2010). In Argentina, the wholesale electricity prices as well as the real average tariffs fell from the 1992 levels as a result of increased competition due to industry restructuring and privatization even though the price froze in the wake of an economic crisis in 2002 due to the devaluation of the national currency (Haselip and Potter, 2010). Average node prices for electricity also declined in Chile from the 1982 levels with the implementation of reforms while prices reduced by 30% in Argentina (Pollitt, 2004). Nonetheless, assessing the causal effect of the price fall for low-income groups is complicated in Chile as targeted subsidies and electrification policies can also produce the effect rather than strictly privatization (Paredes, 2001). In Colombia, prices reduced by 20% (Ayala and Millan, 2003).

In other developing countries, the impacts of electricity reform on electricity prices are opposite of that in Latin American countries. For example in Turkey privatization of electricity distribution systems did not yield the expected retail price declines in the initial years of reforms program despite the fact that wholesale tariffs exhibited a reduction (retail price increased by 6% while wholesale price decreased by 10% (Karahan and Toptas, 2013). Similarly, in Africa, electricity prices have been generally high before and after sector reforms.[3]

[3] In most Sub-Saharan African countries, the average electricity tariff remained almost twice as high as in other parts of the world regardless of whether this was before or after the reforms. The prevailing high electricity tariffs

Reforms also had no impact on the electricity prices of South Asian countries like Bangladesh and Pakistan where electricity prices are not cost-reflective and politically determined (Bhattacharya, 2007). Electricity prices continue to be below the cost recovery levels giving rise to high commercial losses among the transition countries such as Georgia, Moldova, Ukraine and the Commonwealth of Independent States (CIS) since reforms started in the early 1990s (Nepal and Jamasb, 2012a). The difficulty of the socially vulnerable consumers to absorb further price increases (low affordability) has often prevented pursuing tariff reforms in many transition countries (Fankhauser and Tepic, 2007). In Turkey, the introduction of a tariff system reflecting costs differently affected the production and consumer prices of electricity. The effect on consumer prices was slightly lesser than for producer prices (Akkemik, 2011).

Table 4: Reforms and Electricity Prices

Study	***Approach***	***Region***	***Data***	***Method***	***Policy impacts and relevance***
Nagayama (2007)	econometric	global	panel data: 83 countries (26 developed); 1985-2002	ordinary least squares, fixed effects, random effects	neither unbundling nor introduction of a wholesale pool market on their own necessarily reduces the electricity prices; unbundling may work to reduce prices when coexistent with an independent regulator
Nagayama (2009)	econometric	global	panel data: 78 developing, developed and transition countries; 1985-2003	ordered response, fixed effects, random effects	higher electricity price drive liberalisation; liberalisation models does not necessarily reduce electricity price
Erdogdu (2011)	econometric	global	panel data: 63 developed and developing countries, 1982-2009	fixed effects, random effects	no uniform pattern for the impact of reforms process as a whole on price-cost margins and cross-subsidy levels;

in these countries do not cover the full costs of electricity supply. Countries like Angola, Malawi, South Africa, Zambia and Zimbabwe have maintained highly subsidized low prices below the cost levels (Eberhard et al. 2011).

					different impact of different reform steps
ESMAP (2011)	econometric	global	panel data; 20 countries with different system sizes	Fixed effects, random effects	vertical unbundling reduced electricity tariffs by 10 percent
Sen and Jamasb (2012)	econometric	India	panel data: 19 Indian states, 1991-2007	bias corrected fixed effects	political economy factors giving rise to adverse outcomes in the initial stages of reforms
Kundu and Mishra (2011)	econometric	Indian state of Orissa	survey based approach	partial least squares	some consumers group benefited (such as industrial) while some lost (such as agricultural)
Estache and Rossi (2004)	econometric	Latin America	distribution companies of 14 countries,	correlation	fall is prices in general did not match the productivity gains
Balza, Jimenez and Mercado (2013)	econometric	Latin America	panel data: 18 countries, 1971-2010	generalised least squares	no robust results in terms of privatisation and end-user-prices; strong and robust association between regulatory quality and electricity prices
Anaya (2010)	cost-benefit analysis	Peru	electricity distribution companies (privatised and non privatised)	single country	privatisation contributed to price increase
Haselip and Potter (2010)	case study	Argentina	power sector indicators	single country	reforms led to price decline until macroeconomic crisis
Pollitt (2004)	case study	Chile	power sector indicators	single country	average node prices declined after reforms
Karahan and Toptas (2013)	case study	Turkey	power sector indicators	single country	no reduction in retail electricity prices after reforms

Eberhard et al. (2011)	case study	Africa	power sector indicators	multi-country	eliminating pricing inefficiencies can close the funding gap in the power sector
Bhattacharya (2007)	case study	South Asia	power sector indicators	multi-country	reform undertaken produced no significant results, electricity prices still highly subsidised
He et al. (2011)	macro study	China	coal and electricity prices	CGE modelling	coal price increase caused a rise in the costs of electric power industry while the influence gradually descended with increases in coal price
Kennedy (2003)	case study	Transition economies	power sector indicators	multi-country	implementation of reform should be enhanced to improve reform performance
Fankhauser and Tepic (2007)	case study	Transition economies	affordability indicators for utilities	multi country	level of tariffs needed for cost recovery bear important affordability consequences
Akkemik (2011)	case study	Turkey	macro and micro variables with focus on energy producing sectors	single country; social accounting matrix	cost reflective electricity tariff affect consumers prices slightly less than producer prices

3.1.2. Impacts of reforms on quality of service and access

One of the principal aims in most reforming countries was to enhance the quality of energy supply (Joskow, 1998; Briceno-Garmendia et al., 2004). Reforms were expected to enhance energy production, lead to efficient utilisation of existing capacities and add new capacities by attracting investments and reduce energy losses. Studies, such as Cubbin and Stern (2004, 2006), Erdogdu (2014) and Zhang et al. (2008), find that market competition and increased

regulatory governance as result of power sector reforms have brought enhanced service penetration, generation capacity expansion, utilization of generation capacity and reserve margin in some developing countries.

The effects of reforms on quality and access have differed across different development regions as showed by Nagayama (2010) based on econometric methods for panel data analysis. The introduction of foreign IPPs when coexistent with independent regulators and unbundling on its own increased per capita generation capacity in Asian developing countries while the establishment of an independent regulator produced an opposite effect. The per capita generation capacity increased among the LACs with the introduction of wholesale power market and power exchange. The reform impacts have triggered different impacts on electricity transmission and distribution (T&D) losses (Nagayama, 2010). The introduction of foreign IPPs decreased T&D losses in Asian developing countries while it had the opposite effect in Latin America along with the establishment of an independent sector regulator. The introduction of wholesale power market increased T&D losses in Asian developing countries as the amount of power traded increased.

On the other hand, private sector investments in the transmission and distribution networks contributed to a decline in electricity losses in Latin America (Balza, Jimenez and Mercado, 2013). Technical and non-technical losses fell sharply from above 20% in 1992 to just above 10% in 2007 in Argentina (Pollitt, 2008). The number of minutes of supply interruption per year fell to 2.1 in 2003 from 9.6 in 1997 in Chile while distribution losses fell from 19.8% in 1987 to 5.6% in 2003 (Pollitt, 2004). Generation capacity also increased in many LACs except Brazil post reforms (Millan, 2005).

Reforms triggered different impacts on the plant load factor, T&D losses and gross electricity generation among the Indian states (Sen and Jamasb, 2012). Unbundling and tariff orders had a positive and significant effect on plant load factors. Introduction of independent regulation, unbundling and privatisation of distribution segment contributed to increases in T&D losses. Gross electricity generation in India increased with the introduction of the IPPs while privatisation of the distribution segment led to decline in electricity distribution losses. The average level of T&D losses in Sub-Saharan Africa was around 27.5% in 2009 although the system losses substantially ranges from 14.5% in Angola to 68% in Swaziland (ESMAP, 2009). Reforms have also been unable to reduce electricity theft in most regions of the developing world considering that the quality of governance such as effective accountability, political

stability, and government effectiveness and corruption control can reduce energy theft in developing countries (Smith, 2004).

The international experience with electricity restructuring, privatisation and liberalisation has exposed the vulnerabilities in electricity supply in various countries (Hall, 1999). For example, the end of 1997 saw repeated power cuts in Rio de Janerio, Brazil followed by Buenos Aires, Argentina where a 10-day blackout occurred in 1999 while India experienced one of its largest blackouts, which affected 20 Indian states in 2012. These supply vulnerabilities coincide with the less than anticipated increase in private investments across the electricity networks segments (both transmission and distribution) in the electricity industries of developing countries with the progress in reforms. In addition, the progress toward electricity sector reforms has coincided with limited degree of government support for research and development (R&D) activities that potentially threaten the sustainable efficiency improvements in the electricity industries of developing countries (Erdogdu, 2013).

Electricity reforms in developing countries were often mooted with a view to increase access across all segments of the population (Sinha, 2003). This is because the participation of the private sector in energy production/generation provides more investment to expand the electricity supply capacity and thus would enhance access to electricity. However, the available evidence suggests that electricity sector reforms do not necessarily accelerate energy access.

Systematic information is also lacking to indicate an enhanced access of electricity to the poor due to the power sector reforms (Prasad, 2008; Haanyika, 2006). For example, the Indian state of Orissa, which underwent a deep reform program, experienced a decline in the electrification rate after reforms (Sihag et al., 2007). The unaffordability of electricity by the poor also imply that any reform initiatives aimed at intensifying rural electrification has little impact in improving the energy access of the poor (Bhattacharya, 2006).

Evidence from Latin American countries suggests that private sector investments, improvements in regulatory quality and overall institutional reforms significantly improved the electricity coverage in the region (Balza, Jimenez and Mercado, 2013). Electricity coverage has been a notable success in South America after reforms where the post-reform electrification levels have considerably increased from the pre-reform levels (Kozulj and Di Sbroiavacca, 2004). For example, the post-reform electrification rates in Argentina, Peru and El Salvador respectively increased to 95, 72 and 76% from the respective pre-reform rates of 91, 38 and

62%. The number of households without electricity supply in Chile decreased to 14% in 2002 from 62% in 1982 after reforms (Pollitt, 2004).

Table 5: Reforms and Electricity Quality/Access

Study	***Approach***	***Region***	***Data***	***Method***	***Policy impacts and relevance***
Cubbin and Stern (2004)	econometric	global	panel data: 28 developing countries; 1980-2001	OLS, fixed effects	regulatory law and governance positively related to higher per capita electricity generation and capacity
Cubbin and Stern (2006)	econometric	global	panel data: 28 developing countries; 1980-2001	fixed effects, error correction models	regulatory law and governance positively related to higher per capita electricity capacity controlling for privatization and competition
ESMAP (2011)	econometric	global	panel data; 20 countries with different system sizes	fixed effects; random effects	introduction of independent regulation escalated access by 50 percent
Zhang, Parker and Kirkpatrick (2005)	econometric	global	panel data: 25 developing countries, 1985-2001	fixed effects	independent regulation and competition before privatisation important for higher electricity generation and capacity
Zhang, Parker and Kirkpatrick (2008)	econometric	global	panel data: 51 developing countries, 1985-2000	fixed effects	on their own privatisation and regulation do not lead to obvious gains in economic performance
Erdogdu (2014)	econometric	global	panel data: 55 developed and developing countries, 1975-2010	fixed effects, random effects	reform progress led to higher levels of electricity supply self-sufficiency
Nagayama (2010)	econometric	global	panel data: 86 developed and developing	fixed effects	IPPs, unbundling, regulatory agency and creating wholesale

			countries, 1985-2006		markets reduced transmission and distribution losses
Nepal and Jamasb (2012a)	econometric	Transition economies	panel data: 27 countries, 1990-2010	bias corrected fixed effects	power sector reform on its own did not produce any significant impacts on T&D losses
Nepal and Jamasb (2012b)	case study	Nepal	power sector indicators	single country	electricity losses in South-Asia including Nepal still remain high, capacity and power shortages prevail
ESMAP (2009)	case study	Sub-Saharan Africa	power sector indicators	multi country	high number of outages per year and long delays with electrical connections
Pollitt (2008)	case study	Argentina	power sector indicators	single country	reforms successful in improving quality prior to the collapse of Argentine peso
Millan (2005)	case study	Latin America	power sector indicators	multi country	generation capacity expanded vigorously except in Brazil after reforms
Smith (2004)	case study/econometric	global	102 countries: electricity losses, governance indicators for 1980 and 2000	correlation/ multi country	losses have increased in many developing countries after reforms
Hall (1999)	case study	global	power sector indicators	multi-country	reforms have coincided with rising power cuts and blackouts
Erdogdu (2013)	econometric	global	panel data: 27 countries, 1974-2008	fixed effects; random effects	reform progress led to decline in R&D investments
Prasad (2008)	case study	Africa	energy sector indicators	multi-country	energy reforms only impacts access when adjusted to local conditions of the poor

Kozulj and Sbroiavacca (2004)	case study	Latin America	power sector indicators	multi-country	electrification levels increased after reforms

3.1.3. Impacts of reforms on productivity and economic efficiency[4]

The changes in energy market structures together with changes in the role of the state and regulation of the sector were aimed at improving utility efficiency and productivity levels through the introduction of market competition (Wolfram, 1999). The evidence of reforms in improving efficiency and productivity in the electricity sector is positive especially in Latin America, which also remains the most studied region. However, efficiency and productivity impacts of reforms remain least studied in South Asia and Africa. There are only few studies analyzing utility efficiency and reforms at the global levels.

An earlier study by Yunos and Hawdon (1997) found that changes in ownership did not automatically resolve efficiency problems in the absence of competition among the least developed countries where significant efficiency gaps persisted between small scale and large-scale electricity providers. Rodriguez-Pardina and Rossi (2000) finds some evidence that suggest that countries, which reformed their electricity sector, had a better performance than those, which did not. Although technical efficiency among the major electricity distribution companies in South America marginally improved between 1994 and 2001, the results suggested considerable scope for improving efficiency among the firms (Estache, Rossi and Ruzzier, 2004). The increments in productivity seem to be in line with the degree of incentives built in regulation while private companies under rate of return regulation exhibited similar labor productivity as public firms (Estache and Rossi, 2005).

The labor productivity in the electricity distribution experienced an increase after reforms in Argentina (Pollitt, 2008). Labor productivity in electricity distribution also increased in Chile since the privatisation of leading companies (Fischer, Gutierrez and Serra, 2003). The incorporation of distribution value added (VAD) in the tariff fixation processes of the electrical power distribution contributed to driving the efficiency of the distribution sector in Chile (Sanhueza, Rudnick and Lagunas, 2004). In Brazil, privatisation had no statistically significant

[4] Economic efficiency is a combination of technical and allocative efficiency (Coelli et al., 2005). Firms operating on the production frontier are said to be technically efficient while allocative efficiency in input selection imply selecting that mix of inputs (such as labor and capital) that produces a given quantity of output at minimum cost (given the input prices which prevail). Productivity of a firm is the ratio of the output(s) that it produces to the input(s) that it uses.

impact with operating expenditures as input but technically efficiency dropped when considering total expenditures (Motta, 2004). This makes case for including capital costs in any benchmarking exercise. Overall, the reform processes as well as the incentives generated in the reform process in Brazil do not seem to have led the firms to behave in a more efficient manner between 1998 and 2005 (Ramos-Real et al., 2009).

Bonifaz and Santin (2000) found out that privatised firms did not outperform state enterprises arguing that privatisation did not lead to an improvement in terms of efficiency among Peruvian electricity distribution companies. The post reform experience suggested insufficient evidence for technical change or significant savings associated with technological improvements in the sector (Bonifaz and Rodriguez, 2001). Improvements in efficiency and productivity of electricity distribution in Peru have occurred with the adoption of regulatory reforms in the Peruvian electricity sector although privatisation proved to be advantageous only in the initial years after the reform (Perez-Reyes and Tovar, 2010). There seem to be a positive relationship between the restructuring and reforms of the electricity distribution sector and enhancement of productivity in Peru (Perez-Reyes and Tovar, 2009). Management practices seem to be important in the Peruvian electricity distribution due to which private utilities are less inefficient than public utilities (Bonifaz and Jaramillo, 2010).

In Colombia, reforms of the 1990s seem to have improved the average efficiency levels of electricity distribution with regulatory policy engendering a positive effect while ownership has produced no conclusive effect (Pombo and Ramirez, 2002a). Technological improvements and regulatory policy have had a positive effect on average efficiency but the divide between good performers and bad performers increased after reforms (Pombo and Ramirez, 2002b). Mello and Espinoza (2004) found no significant changes in the productivity levels among the 20 distribution companies between 1993 and 2003, although environmental variables mattered significantly. In contrast, Pombo and Taborda (2006) showed that plant efficiency and productivity increased after the regulatory reform of 1994 although the efficiency of distribution companies did not improve after the reforms. Nonetheless, the Colombian electricity distribution exhibits high inefficiency persistence and heterogeneity among firms (Galan and Pollitt, 2014). Rural companies and firms with small customers seem to have experienced the largest efficiency gains over the 15 years after the reforms.

In Sub-Saharan Africa, the results obtained from the efficiency analysis of the Côte d'voire electricity companies could not reject the hypothesis of a significant performance improvement

in post-privatization period while the technical efficiency measures have behaved irregularly since privatization (Plane, 1999). Meanwhile, Estache et al. (2008) attempted at documenting efficiency levels in Africa's electricity firms based on a sample of 12 operators providing services in the 12 country members of the Southern Africa Power Pool. The study relied on the DEA decomposition technique to estimate the changes in total factor productivity (TFP). The results showed comparable levels of efficiency and performance levels in the region while finding no clear correlation of efficiency improvements with the adoption of reforms.

A number of studies have focused on efficiency and productivity analysis of electricity reforms in the transition economies of Eastern Europe. The efficiency analysis based on the Ukrainian privately and publicly-owned electricity distribution firms in the context of a new regulatory authority and distribution utility privatisations suggested that privately-owned firms responded to policies and incentives associated with reducing commercial and non-commercial network losses than publicly owned firms (Berg et al., 2005). In Poland, technical efficiency among the electricity distribution companies increased during the transition process while allocative efficiency deteriorated (Cullman and von Hirschhausen, 2008a). The cross-country level analysis suggested that the Polish ddistribution companies were marginally inefficient while the Czech Republic featured the highest efficiency (Cullman and von Hirschhausen, 2008b). Slovakia and Hungary occupied the middle range. This implies that privatization had a positive effect on technical efficiency in all four countries. The average efficiency of thermal generation plants also grew in China as autonomy from the central government was one of the important determinants of efficiency (Lam and Shiu, 2004). In Turkey, private distributors had better technical scale efficiency on average during the early years of reforms (Bagdadioglu et al., 1996; Celen, 2013).

A limited number of studies have been carried out to assess the efficiency and productivity of electricity reforms in developing Asian countries. The performance and efficiency analysis of Indian electricity generation companies supported the policy of unbundling the power sector while state owned companies appeared inefficient (Jain et al., 2010). However, privatisation brought about different impacts among employees productivity in the state of Orissa as some employees felt benefits while others did not (Kundu and Mishra, 2012). In contrast, technical performance in the Thai electricity industry was found to be mainly driven by technological and productivity improvements (Wattana and Sharma, 2011). In the Philippines, productivity in the sector did not improve significantly despite reforms being instituted in 2001 (Bautista et al., 2011). Similarly, the empirical analysis by Nakano and Managi (2008) showed that

regulatory reforms have contributed to productivity growth in steam power-generation sector in Japan for the period 1978-2003. Deregulation of the Japanese power industry also contributed to productivity growth (Goto and Sueyoshi, 2009). In China, unbundling of the integrated electricity utility-the State Power Corporation (SPC) improved productivity and operational efficiency among the large coal-fired power plants controlling for substantial heterogeneity in the technical profile of the plants (Zhao and Ma, 2013).

Table 6: Reforms and Efficiency and Productivity

Study	***Approach***	***Region***	***Data***	***Method***	***Policy impacts and relevance***
Pollitt (1995)	non-parametric	global	768 thermal plants from 14 countries including South Africa and Thailand	DEA with 2nd stage regressions /Tobit	privatisation did not lower costs in the short run, government interference with investment increase costs
Yunos and Hawdon (1997)	non-parametric	least developing countries	cross-section generation data for 27 countries, panel of electricity generating utilities from Malaysia, Thailand and the UK for 1975-1990	DEA	changes in ownership do not resolve efficiency problems in the absence of competition, efficiency gaps between small scale and large scale providers
Rodriguez-Pardina and Rossi (2000)	parametric	South America	30 electricity distribution companies from 10 countries 1994-1998	stochastic production function	partial evidence of reformers performing better than non-reformers
Estache, Rossi and Ruzzier (2004)	parametric/ non-parametric	Latin America	84 electricity distribution companies 1994-2001	stochastic cost function, DEA, labor requirement function	technical efficiency marginally improved but scope for efficiency improvement exists
Estache and Rossi (2005)	parametric	Latin America	127 distribution companies 1994-2001	stochastic production function/labor	incentives in embedded in regulation crucial

				requirement function	for productivity increases
ESMAP (2011)	parametric	global	distribution companies from 20 countries with different system sizes	fixed effects; random effects	Introduction of independent regulator increased labor productivity by twice as high as systems that have introduced regulation
Sanhueza, Rudnick and Lagunas (2004)	non-parametric	Chile	35 distribution companies for the year 2000	DEA	incorporating distribution VAD led to improvements in efficiency
Malik et al. (2015)	parametric	India	unbalanced panel of 385 electricity generating units for the years 1998-2009	panel data econometric based in fixed effects	states unbundling before the Electricity Act of 2003 experienced improvements in operational efficiency especially after 3-5 years after unbundling
Motta (2004)	parametric/ non-parametric	Brazil	distribution companies 1994 and 2000	DEA/Stochastic production frontier	Privatisation has no effect on operating cost efficiency, makes case for including capital costs in benchmarking
Ramos-Real et al. (2009)	non-parametric	Brazil	panel of 18 distribution companies from 1998-2005	DEA	incentives generated in the reforms process incapable of making firms behave in more efficient manner
Bonifaz and Santin (2000)	non-parametric	Peru	panel of 19 distribution operators 1995-1998	DEA with 2nd stage regressions	privatisation did not lead to an improvement in terms of efficiency
Bonifaz and Jaramillo (2010)	parametric	Peru	panel of 19 distribution companies for the period 2000-2008	stochastic cost frontier	private utilities are less inefficient than public utilities due to better management practices

Perez-Reyes and Tovar (2009)	non-parametric	Peru	14 distribution companies for the period 1996-2006	DEA	reforms led to improvements in efficiency and productivity
Perez-Reyes and Tovar (2010)	parametric	Peru	14 distribution companies between 1996 and 2006	distance function	incentives lead by the reform process made firms more efficient
Pombo and Ramirez (2002a)	non-parametric	Colombia	panel of 33 distribution companies from 1988-2000	DEA with 2nd stage regression	reforms improved average efficiency levels
Pombo and Ramirez (2002b)	non-parametric	Colombia	panel of 33 generation and 12 distribution companies 1988-2000	DEA with 2nd stage regression	technology improvements and regulatory policy had positive effect on average efficiency levels
Mello and Espinoza (2004)	parametric	Colombia	panel of 20 distribution companies 1999-2003	Free Disposal Hull (FDH)	environmental variables mattered significantly
Galan and Pollitt (2014)	parametric	Colombia	panel of 21 electricity distribution firms for the period 1998-2012	dynamic SFA model	increases in efficiency among rural firms only manifested during the last five years driven by improvements in service quality and energy losses occured
Plane (1999)	parametric	Côte d'Ivoire	time-series from 1959-1995	stochastic production function	significant but irregular gains from the privatization of management
Estache, Tovar and Trujillo (2008)	non-parametric	Southern African countries	12 operators of 12 different countries, 1998-2005	DEA	no clear correlation between between adoption of reforms and improvements in efficiency
Berg, Lin and Tsaplin (2005)	parametric/ non-parametric	Ukraine	24 distribution companies, 1998-2002	stochastic production frontier/DEA	private operators responded well to incentives than public operators, perverse

					regulation worsens incentives
Cullman and von Hirschhausen (2008a)	parametric/ non-parametric	Poland	32 distribution companies between 1997 to 2002	DEA/SFA	technical efficiency improved with reforms but allocative efficiency deteriorated
Cullman and von Hirschhausen (2008b)	non-parametric	Poland, Czech Republic, Slovakia, Hungary	47 Eastern European regional companies, 37 German companies	DEA/Free Disposal Hall	Czech Republic and Slovakia feature the highest efficiency, privatisation had a positive effect in all countries
Lam and Shiu (2004)	non-parametric	China	panel of 30 municipal autonomous regions and provincial thermal generation plants 1995-1996	DEA with 2nd stage regressions	average efficiency increased at 2%
Bagdadioglu, Price and Weyman Jones (1996)	non-parametric	Turkey	cross section of 70 distribution operators in 1991	DEA	Private operators are more efficient than public operators
Celen (2013)	non-parametric	Turkey	21 companies for the period 2002-2009	DEA with 2nd stage regression/Tobit	private ownership positively affect efficiencies
Jain, Thakur and Shandilya (2010)	parametric/ non-parametric	India	30 state –owned utilities for the year 2007-2008	DEA/SFA	unbundling drives efficiency in electricity generation
Wattana and Sharma (2011)	non-parametric	Thailand	Thai electric industry, time series data from 1980-2006	DEA	industry reforms not significant in driving efficiency
Bautista, Agnes and Valderrama (2011)	non-parametric	Philippines	120 electric cooperatives, 2001 to 2006	DEA	reforms did not drive productivity in the sector
Nakano and Managi (2008)	parametric/ non-parametric	Japan	10 companies, 1965-2003	DEA/ generalised method of moments	regulatory reforms have contributed to productivity growth in the steam power-generation

Goto and Sueyoshi (2009)	parametric	Japan	annual observations in 9 companies from 1983-2003	multi-product translog cost function, random effects maximum likelihood estimator	improvements in productivity growth after deregulation
Pombo and Taborda (2006)	non-parametric	Colombia	12 electricity distribution companies from 1985 to 2001	DEA	profitability, partial input productivity, and output improved; plant efficiency and productivity increased after the reform
Zhao and Ma (2013)	non-parametric	China	balanced panel: 34 large power plants for the period 1997-2010	DEA	Operation efficiency improved on average, unbundling boosted productivity

3.2. Macroeconomic Impacts of Electricity Sector Reforms

In this section, we review the relevant literature analyzing the impacts of electricity sector reforms on macroeconomic indicators such as economic welfare, economic growth and poverty reduction. Electricity is one of the main inputs to economic growth especially in developing countries where economic development is constraint due to lack of infrastructure including reliable supply of electricity. Therefore, any programs and policies that relax the electricity supply constraints are expected to generate positive impacts on economic welfare and growth and also reduce poverty. In this section we present some evidence to support this argument.

3.2.1. Impacts of reforms on economic welfare

The economy-wide welfare impacts of power sector reforms are reported by a few studies. Galal et al. (1994) that estimated the welfare impacts of the privatisation of the Chilean distribution and generation companies, is one of the first and most comprehensive studies assessing welfare implications of power sector reforms. The privatisation of the Chilean electricity companies (an electricity distribution and a power generation) led to a permanent gain in social welfare equivalent to 2.1% of 1986 sales value. However, the gains were achieved at a fiscal loss and two-thirds of the aggregate gains went to foreign shareholders. In Brazil, the privatization of the electricity distribution during the period 1995-2000 when

approximately 60% of privatisation occurred created a one-off gain equal to 2.5% of the GDP while producers gain around two-thirds of the benefits (Mota, 2003). Consumers could have benefited more from privatization since the start the presence of tougher regulation. The economic welfare impacts of partial privatization and restructuring of the Peruvian electricity market also proved worthwhile as the gains amounted to 542 million US dollars in 2007 prices (Anaya, 2010). The distributional gains suggested that government and producers benefited the most from welfare gains while consumers benefited the least.

Toba (2007) studied the welfare impacts of introduction of private sector participation into the Philippine electricity generation sector, through liberalization of the market for IPPs during the power crisis of 1990-1993. The introduction of IPPs presented significant gains contributing to resolving the crisis and promoting economic and social development while consumers and investors were net gainers. However, only about one-quarter of the total private investors' gain is transferred to the domestic investors, as most of the investors are assumed to be foreigners. The largest portion of the net benefit equivalent to a net present value of 10.4 billion US dollars (in 1999 prices) was distributed to consumers while both domestic and foreign investors also gained. The government was the loser. In Israel, Tisher et al. (2006) undertook a cost-benefit analysis summarizing the government's reform plan using an unregulated regime as the counterfactual. The results suggested that the government's reform plan would only yield a small net benefit even when carried out flawlessly relative to the regulated regime. The reforms will also lead to large increases in electricity producer profit and government tax receipts at the expense of the electricity consumers. As such, a less-than-perfect transition to competition could easily preclude the potential gain of the government plan.

Table 7: Reforms and Economic Welfare

Study	***Approach***	***Region***	***Data***	***Method***	***Policy impacts and relevance***
Galal et al. (1994)	multi-country case studies	global	public enterprises divestitures in UK, Chile, Malaysia and Mexico; analyses the privatisation of the power sector in Chile	social cost-benefit analysis	privatisation when combined with proper regulatory framework can be welfare enhancing, private ownership improves efficiency of generation, promote profit

					maximisation and increases the value of regulation
Mota (2003)	single country case study	Brazil	privatisation of electricity distribution and supply businesses between 1995-2000	social cost-benefit analysis	economic welfare (net benefits) was significant but most of it went to the producers; consumers could have benefited more from privatisation in the presence of tougher regulation
Anaya (2010)	single country case study	Peru	privatisation of electricity distribution companies: Electrolima and Electro Sur Medio	social cost-benefit analysis	privatisation was worthwhile in terms of social welfare, government and producers benefited the most while consumers the least due to price increases
Toba (2007)	single country case study	Philippines	liberalisation of the electricity generation sector between 1990-1993	social cost-benefit analysis	consumers and investors were net gainers while the government lost, reform with private sector participation increased economic welfare
Tishler et al. (2006)	single country case study	Israel	in accordance to the 2003 Israeli government announcement to undertake a comprehensive reform of the electricity sector based on the standard reform model	cost-benefit analysis	the reform plan will only yield a small net benefit even when carried out flawlessly, will increase the profit for producers and tax receipts for the government at the expense of customers, performance-based regulation of the sector thereby is desirable

3.2.2. Impacts of reforms on economic growth

A few studies have provided evidence of positive impacts of power sector reforms on economic growth. For example, Sen and Jamasb (2012) empirically show the increased stock of electricity infrastructure has made a significant contribution to its industrial economic output Existing literature such as Easterly and Levine (2003), Rodrik et al. (2004) and Acemoglu and Robinson (2010) also establish the positive relationship between stock (as well as quality) of infrastructure and per capita GDP growth.

Empirical evidence also suggests a strong positive link between regulatory quality in all economic sectors and economic performance such as economic growth in developing countries (Jalilian, Kirkpatrick and Parker, 2007). Electricity reforms can stimulate economic growth by improving access to electricity and electricity consumption (Ozturk, 2010). However, only a few studies have directly examined whether energy sector reforms serve as the determinants of economic growth where per capita GDP and overall employment are used as an indicators of economic growth.

Nepal and Jamasb (2012a) examined the impact of power sector reforms on per capita GDP in the transition countries which predominantly includes countries belonging to the Former Soviet Union. The empirical results show significant positive impacts of reforms on GDP. The results also hold for the growing Indian economy as evidenced from the empirical results by Sen and Jamasb (2012). Their study econometrically analyzed the determinants and impact of electricity reform in the Indian states, giving special regard to its political economy and regional diversity.

Chisari et al. (1999) estimated the macroeconomic effects of the privatisation and regulation of utilities including the energy sector that began since 1989 in Argentina. The privatization of electricity generation and distribution and gas all had positive effect on GDP. The privatisation of the gas sector had the greatest effect on GDP amounting to 0.31% rise in GDP in the presence of good regulation. Privatization of energy utilities did not contribute to the dramatic rise in unemployment between 1993 and 1995. The fiscal consequences of privatization and regulation of infrastructure utilities including energy suggested that the country gained more in macroeconomic terms from the net present value of subsidy cuts (Benitez et al., 2001).

Reallocating the resources freed up by energy subsidies removal to more productive public spending can help boost economic growth over the long run (IMF, 2013)

Table 8: Reforms and Economic Growth

Study	***Approach***	***Region***	***Data***	***Method***	***Policy impacts and relevance***
Chisari, Estache and Romero (1999)	macro study	Argentina	performance data before and after privatisation of the argentine utilities	CGE model	privatisation resulted in different kinds of efficiency gains with significant macro-economic benefits, privatisation not the cause for rising unemployment
IMF (2013)	case study	global	energy and economy level data	multi-country	subsidies removal boost economic growth in the long run
Benitez, Chisari and Estache (2001)	macro study	Argentina	privatisation, fiscal reforms and regulation data	CGE	country gained more from subsidy cuts and reforms and privatisation of energy utilities not responsible for increased unemployment
Nepal and Jamasb (2012a)	econometric	transition economies	panel data: 27 countries, 1990-2010	bias corrected fixed effects	power sector reform on its own did not produce any significant impacts on T&D losses
Sen and Jamasb (2012)	econometric	India	panel data: 19 Indian states, 1991-2007	bias corrected fixed effects	reforms positively affected the GDP

3.2.3. Impacts of reforms on poverty alleviation

Existing literature on infrastructure reforms and poverty linkages shows that policy changes to improve the access and quality of infrastructure services help reduce poverty through direct and indirect channels, such as providing more opportunities to generate income, improving health and educational outcomes (Estache and Fay, 1995; Brenneman and Kerf, 2002). Hence, power sector reforms aimed at improving the access and supply reliability contributes to poverty reduction. However, existing studies have not empirically examined this issue and explored the evidence to investigate this hypothesis. In fact, some studies examining this issue

empirically (e.g., Victor, 2005) found no inherent connection between energy markets reforms and the promotion of welfare for the poorest households although energy consumption and economic growth are correlated.

The extent to which power sector reform affects poor people primarily depends on their ability to access electricity. For example, energy poor also tend to be income poor as evidenced from India establishing a clear link between income poverty and energy poverty (Khandker, Barnes, Samad, 2012a). Rural electrification also helped reduce poverty in India even though the larger share of benefits accrued to wealthier rural households (Khandker et al., 2012). In addition, grid electrification in Bangladesh generated significant positive impacts on household income, expenditure and education where the household gain in total income due to electrification was around 21%, with a 1.5 percentage point reduction in poverty per year (Khandker et al., 2012b). Similarly, access to communal grid electricity generated externality benefits for the poor than the rich in Vietnam while access to household electricity benefited the rich than poor questioning the rural electrification's long term benefits for the overall rural economy (Khandker, Barnes and Samad, 2013).

The efficiency gains from privatization of energy utilities in Argentina accrued mostly to high-income classes, while gains from the effective regulation of newly privatized utilities accrued mainly to low-income classes (Chisari et al., 1999). All income groups benefited from reforms while the distribution of income also improved (Navajas, 2000). In general, incidences of final electricity price fall were experienced post reforms in Latin America although the price fall did not translate into increased affordability and access to electricity to the poor households. The electric utilities and the governments shared most of the gains in the form of rents and higher tax revenue (Estache and Rossi, 2004). In Peru, electricity consumers, which constitute the majority of the population, benefited the least from reforms as welfare gains were offset by increases in prices (Anaya, 2010). Nonetheless, the welfare consequences of getting connected to electricity networks are high.

Some studies have examined distributional impacts of some components of power sector reforms, such as electricity pricing reforms. Boccanfuso et al. (2009a) assess the distributional effects of electricity pricing reform in Senegal. The analysis found that increases in electricity prices bear little direct impact on most poor households as only few poor households are connected to network. Compensating measures such as cash transfers in the face of electricity price increase slightly decreases income inequality between poor and rich households. Similar effects were observed regarding the distributional and poverty-related effects of price reform

in the electricity sector of Mali, a poor country in West Africa (Boccanfuso et al., 2009b). The increase in electricity prices did not affect poverty directly as very few poor households are connected to the electricity grid while households also decrease their electricity consumption when price rises. Unlike in Senegal, compensating measures such as cash transfer after price rise did not help the low-income households losing from pricing reform. Based on the broad trends of energy reforms across the African countries, Clark et al. (2005) show that the impacts of reforms on the poor are neither direct nor inevitable.

Table 9: Reforms and Poverty Reduction

Study	***Approach***	***Region***	***Data***	***Method***	***Policy impacts and relevance***
Victor (2005)	case study	global	energy sector indicators	multi-country	energy access and development correlated; link between reforms and poverty reduction complex and non-inherent
Khandker, Barnes and Samad (2012a)	econometric	India	cross-sectional survey data for households in 2005	probit estimates	energy poverty and income poverty are directly linked to each other
Khandker, Barnes and Samad (2012b)	econometric	Bangladesh	cross-sectional survey data for households in 2005	propensity score matching	electrification led to household gains in income and poverty reduction
Khandker et al. (2012)	econometric	India	cross-sectional survey data for households in 2005	maximum likelihood probit model	rural electrification also helped reduce poverty; larger share of benefits accrued to wealthier rural households
Boccanfuso, Estache and Savard (2009a)	macro study	Senegal	macro –micro variables between 1995 to 2001	CGE model	direct price effects are weaker than general equilibrium effects on poverty and inequality
Boccanfuso, Estache and Savard (2009b)	macro study	Mali	macro –micro variables	CGE model	direct price increases have a minimal effect on poverty and inequality, whereas the general equilibrium effects of

					such increases are quite strong and negative
Clark et al. (2005)	case study	Africa	energy sector indicators, macro variables	multi-country	impacts of reforms on the poor are neither direct nor inevitable
Betily, Movchan and Pugachov (2013	macro study	Ukraine	household survey data for 2009	CGE model	increases in gas prices result in welfare losses across all household categories, with a more profound impact on urban households
Solaymani, Kari and Zakaria(2013)	macro study	Malaysia	time series macro and micro data	CGE model	subsidy removal can potentially lead to significant falls in income of rural households leading to rising poverty levels among the rural households
ADB (2005)	case study	Asia	macro-micro data	multi-country	strong links between investments in energy infrastructure and rural poverty reduction in Thailand and India
Estache, Foster and Wodon (2002)	case study	Latin America	macro-micro variables	multi-country	evidence of reforms on poverty reduction is scarce; hence the analysis remain incomplete

4. Discussions and Policy Implications

A review of the limited literature and evidence on the impacts of electricity sector reforms suggests a growing trend in this research area among the developing and transition countries. The existing reform studies have used both quantitative and qualitative techniques to assess the impact of reforms with no strict preference over one another. Latin America remains the most studied region in the reform literature for two major reasons: a) being one of the pioneers of the market-driven electricity reforms and b) the ability of the Latin American Association of Energy Regulators to generate comparable data.

The reform studies have analysed one or many dimensions of reforms involving changes in electricity market structures, regulation of the sector and changing role of the state on several industry specific micro and economy specific macro variables. The evidence on the performance of reforms remains mixed in developing countries for varied reasons. For example, the mixed results indicate that reforms have not progressed, stalled or recently initiated to produce the intended economic effects in many developing countries. Additionally, even if reforms have advanced, they remain so only in theory such that existing reform practices are incapable of producing real impacts. The reform measures among selective samples may also be inadequate to recognize significant effects while undertaking quantitative (mostly econometric) studies.

Moreover, the mixed results and evidence also reflect the difficulty of undertaking any empirical studies on the performance and determinants of electricity reforms. The reliability of econometric results analysing the effects of reforms often hinges on the availability of a data sample that captures a mix of reform experiences. Electricity reforms and performance data tend to suffer from endogeneity and simultaneity bias. Establishing the effects of reforms typically involve correcting for country or utility specific factors other than reforms but robust evidences are neither guaranteed nor certain. This is because of reforms being multi-dimensional involves a number of simultaneous inter-related steps affected by a vector of political, economic and institutional factors that are difficult to quantify. These factors make it difficult to isolate the effects of particular reform steps or interaction of different reform steps on specific reform outcomes.

The issue of cost-reflective pricing remains at the heart of the success or failure of the reforms. Reforms led to cost-reflective electricity pricing in some countries in Latin America by decreasing the price-cost margin. In the absence of market power abuse and exercise, reforms also led a decline in average wholesale electricity prices but not necessarily the retail prices. Privatization, however, raised the electricity prices allowing the governments and producers to gain from the price rise while affecting the consumers. The existence of an independent regulator and institutional quality seem to facilitate the transition to cost-reflective power pricing and mitigate adverse impacts of price increases. ***Hence, electricity price adjustments should be undertaken before privatization rather than after privatization to minimize the tension between economic efficiency and equity if privatization of the energy companies is considered as an option for reform in developing countries.*** The existence of cross-subsidies

and subsidies for rural electrification in developing countries implies that it is also hard to separate the price only impacts of reforms.

In many developing countries, reforms have led to improvements in operational efficiency of the sector by minimizing energy losses, increasing energy production and energy capacities. For example, the liberalized electricity market model in South America has been relatively successful in attracting investments in generation than the dominant single-buyer model in South Asia. However, power theft still remains common in developing and transition countries despite reforms. This implies that ***establishing social legitimacy and public acceptance of reforms are crucial in tackling the traditional problems of non-commercial energy losses (energy theft) and non-payment of energy in developing countries.*** One possible way to increase the social legitimacy and public acceptance of reforms is by implementing reform programs that adequately reflect the local economic, political and social conditions rather than solely relying on international reform ideologies.

The issue of service quality is mostly associated with the access to energy in developing countries with reforms generating varying impacts. For example, the adoption of market-based reforms in Latin America coincided with an expansion in rural electricity access programs as opposed to countries in South Asia and Sub-Saharan Africa where the lack of electricity access in rural areas remains a national problem. In contrast, South Africa achieved higher electrification without implementing the textbook reform model. The evidence suggests that ***reforms, if undertaken, alone cannot solve the problems of inadequate access to electricity in developing countries in the absence of other complementary socio-economic arrangements***. The existence of side arrangements implies that it is hard to measure the direct impacts of reforms on rural electricity access. Nonetheless, reforms have helped exposing the issue of inadequate rural energy access as major impediments to socio-economic progress in developing countries.

Reforms (mainly privatization and regulation) seem to have largely improved the cost efficiency of electricity utilities in many developing countries. Energy sectors in these countries witnessed major efficiency gains. In that sense, reforms seem to have fulfilled one of its major objectives. However, the gains have not trickled down to the end-users of energy. Evidence suggests that consumers benefited from efficiency gains from privatization in the presence of a good regulatory body while regulators with perverse incentives exacerbated the matter. The inability of the sector regulators to transfer the efficiency gains achieved through reforms to end users through market-based instruments (such as incentive regulation) has led to reforms

being unpopular and negative. From a consumer-welfare perspective, the lessons of experience suggest ***the need to create an independent and competent regulatory body before privatization of electricity utilities***.

Reforms, if carried out properly, enhance economic welfare as documented from the lessons of experience. However, reforms alone are incapable of creating an equitable distribution of welfare among different income groups. The welfare gains from privatization mostly went to both domestic and foreign-owned producers in many instances. Experiences document that the welfare gains from privatisation would have benefited consumers more in the presence of a tougher regulation. The ***importance of a proper regulatory framework in maintaining a balance between welfare maximization and equity considerations is paramount*** in developing countries.

The impact of electricity sector reforms on economic growth is positive. This is not surprising when macroeconomic conditions have often catapulted energy reform in many developing countries. Privatization, if pursued with economic motives, seems to be conducive in macroeconomic terms. However, removal of energy subsidies seems to generate contractionary effects on the economy in the short-run although the long-term effects are positive. Hence, ***energy subsidies reform in developing countries should be appropriately phased, well targeted and transparent while the corresponding prices increases should be sequential and not abrupt*** to maintain economic growth both in the short-term and long run.

The link between electricity sector reforms and poverty reduction remain in-direct, complex and hard to quantify. Evidence suggests a correlation between electricity access and development in developing countries implying that reforms affect poverty in developing countries through access to electricity. For example, the access to electricity in rural Bangladesh increased the welfare of the poor and helped reduce poverty as well. This implies that at a minimum, ***reforms should be aimed at catering the electricity to the poor to produce any significant impacts on poverty reduction*** in developing countries. This indeed is a major challenge considering the costs involved in expanding energy access. For example, it is estimated that the investment cost of providing electricity to Sub-Saharan Africa over a 10-year period is between 160 billion and 215 billion U.S. dollars (Rosnes and Vennemo, 2012). At the same time, it also provides an opportunity to reform the lives of the poor and establish the legacy of market driven reforms in developing countries.

5. Conclusions

This paper reviewed the empirical and theoretical literature on the linkages between electricity reforms; economic and technical efficiency, operational performance, economic growth, economic welfare and poverty reduction in developing countries. The paper achieved this by understanding the context and motivation of energy reforms, reviewing the progress and assessing the factors that shaped the outcomes of reforms, measuring reform performance, exploring the theory and practice of electricity reforms and formulating policy lessons based on the performance of reforms in developing countries. The extent of reforms has varied across developing countries in terms of changes in market structures, the role of the state and the regulation of the sector.

Existing literature suggests that assessing the impacts of electricity reforms has heavily focussed on measuring the operational and economic efficiency and productivity impacts of the reforms. However, the literature studying the macro linkages of the reforms seems scarce. The impact of reforms on the poor is also limited and hard to quantify. Hence, examining the impact of power sector reforms on factors directly affecting poor people was a challenge of the study. The incompleteness of reforms and the interplay among several indirect factors (such as economic, political and institutional) compounds the challenge of properly measuring the reform impacts of individual reform steps.

Overall, from the literature, it is evident that reforms have improved the efficiency and productivity in the sector, although the efficiency gains may not always reach the end consumers. The existence of an independent regulatory body with tougher regulation is necessary in developing countries to transfer the efficiency gains to the customers and ensure that not only producers and the government benefit from privatization. Reforms seem to generate poverty alleviation impacts only when the poor have access to electricity. This implies that reforms should be localized with a view to meet the electricity needs of the poor, which can potentially enhance the welfare of the poor. However, there is a consensus in the literature that the regulatory framework at disposal and the nature of regulation are crucial in balancing the tension between economic efficiency and equity impacts of reforms.

We also found several caveats in the existing reform literature, which future research can potentially address. The welfare analysis of reforms using cost-benefit analysis remains limited in the context of developing countries. The impacts of reforms on electricity network investments are also unclear and under-studied. The competitiveness of wholesale markets and

market power issues also remain to be studied in developing countries in the aftermath of reforms. The existing literature on the empirical evidence of reforms focuses mostly on the electricity sector. Similar studies should be extended to other energy sectors such as coal, oil and gas by facilitating information and data sharing among the energy regulators.

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